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PHYSICS NEWS UPDATE
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Number 531 March 22, 2001 by Phillip F. Schewe, Ben Stein, and James Riordon

A CARBON NANOTUBE INTEGRATED CIRCUIT, with a thousand nanotubes acting like transistors, has been devised by Phaedon Avouris of IBM (914-945-2722, avouris@us.ibm.com). Nanometer-wide tubes made of carbon chickenwire have for some years expected to become an active ingredient in electronics (see Scientific American for December 2000). Besides their strong mechanical properties, nanotubes have a variety of attractive electrical properties. Nanotubes, for example, can sustain current densities hundreds of times greater than that of common metals, and are created in both metallic and semiconducting form. Speaking at last week's APS meeting in Seattle, Avouris described how, in a mixed batch of nanotubes, one can short out the metallic nanotubes (with a surge of voltage) while leaving the semiconducting ones intact for use as circuit elements. Other nanotube highlights from the same meeting: David Tomanek of Michigan State (517-355-9702, tomanek@pa.msu.edu) said that experimental measurements of nanotube heat conductivity went as high as 3000 watts/m/K, almost as high as that of diamond. He predicted that nanotube performance would reach levels of 6600 watts/m/K. The ability to conduct heat will come in handy for future circuits needing to dispose of lots of heat from tight places. Mathieu Kociak of the CNRS lab, University of Paris-South (33-169-155-342, kociak@lps.u-psud.fr) announced the first observation of superconductivity in nanotube ropes (see also Kociak et al., Physical Review Letters, 12 March 2001; get text at http://www.aip.org/physnews/select). "This represents the first observation of superconductivity in a system with such a small number of conduction channels," said Kociak, referring to the meager material substrate over which the supercurrent must flow, namely the aggregate of essentially two-dimensional surfaces of nanotubes. The researchers hope to raise the transition temperatures, presently only 300-400 mK, through judicious doping. John Hafner of Harvard reported using single nanotubes (with diameters of .9-2.8 nm) as extensions on the ends of atomic force microscope probes. Not only does this narrow the probe profile, resulting in greater spatial resolution when imaging a variety of biomolecules (such as immunoglobulins) but, when used to seek out specific molecules on a sample surface, the nanotube probe could help in studying tip-sample adhesion. Hafner referred to this approach as "chemical force microscopy" (CFM). Finally, Masako Yudasaka of the NEC lab in Japan (81-(0)298-50-1190, yudasaka@frl.cl.nec.co.jp) reported on the enormous pressures that arise when C60 molecules are encased inside nanotubes (an arrangement called "peapods" the force on the C60 is only a nano-Newton, but by dividing by the area of the tube, one arrives at a pressure of .1 giga-Pascal. In other words the buckyball can act like a piston for facilitating novel forms of tailored chemistry. Yudasaka also described her work with nanotubes that flare out like cones (typical size: 2 nm small diameter, length of 50 nm, and opening angle of 20 degrees). These "nano-horns" might be useful for absorbing gases (replacing other forms of activated carbon in [illegible])

CORRECTION: Researchers at IBM have not yet made an integrated circuit of carbon nanotubes (Update 531). Rather, Phaedon Avouris and Philip Collins of IBM have announced a scheme for the fabrication of large arrays of nanotubes. They also put together one p-type nanotube transistor and one n-type transistor to form a working logic NOT gate.